Natural Freshwater Springs of the Ballona Watershed: A Comprehensive Historical and Contemporary Analysis

From the Spanish Rancho Period to 2026

Report Date: January 30, 2026 (Revised)
Location: Playa del Rey, California

Executive Summary

This report documents the natural freshwater springs that historically fed the Ballona Watershed, Ballona Wetlands, Ballona Creek, and Centinela Creek from the Spanish Rancho period (1820s-1850s) through the present day. Based on the groundbreaking 2011 Southern California Coastal Water Research Project (SCCWRP) Historical Ecology Study and extensive archival research, **45 springs were mapped** in the watershed during the period 1850-1890, with 70% concentrated in the Santa Monica Mountain foothills[1]. Today, the vast majority of these springs have ceased flowing due to extensive groundwater overdraft.

Key Findings:

1. **45 total springs mapped** in the Ballona Watershed (1850-1890 period)[1]
2. **32 springs** (70%) located in Santa Monica Mountain foothills
3. **13 springs** in the Ballona Valley and other locations
4. Springs clustered from Beverly Hills foothills to Franklin Canyon, then stopped abruptly
5. **Historical total spring discharge:** Estimated 2-5 million gallons/day based on Hall 1888 estimates and documented spring flows[5][86]
6. **Current total spring discharge:** Approximately 50,000-75,000 gallons/day - a **96-98% reduction** from historical levels[42]
7. **Kuruvungna/Tongva Sacred Springs** at University High School: Still active, producing 22,000-25,000 gallons/day (16 gpm) - the watershed's most productive remaining spring (2026)[2]
8. **Centinela Springs**: Historically produced 269,000-404,000 gal/day (1888), developed to 900,000 gal/day capacity (1890); **EXTINCT by 1930s-40s** when water table dropped 150+ feet[3][86]
9. **UCLA Botanical Garden area**: Natural arroyo with springs, now supplemented by reclaimed water system (2024)[4]
10. **2011 field survey:** Only 29 active springs identified with combined flow of just 13,000 gal/day total - springs now account for approximately **2% of dry season baseflow**[42]

11. **Tongva occupation at Kuruvungna:** Archaeological evidence documents over **8,000 years** of continuous human presence[97][99]

I. Historical Overview: The Spring-Fed Landscape

Pre-Development Hydrology (1850-1890)

The Ballona Creek Watershed was characterized by abundant freshwater springs, cienegas (marshlands), and diverse wetland complexes covering approximately **14,149 acres** (5,470 hectares)[1]. State Engineer William Hammond Hall's 1888 irrigation maps document these water sources in unprecedented detail, providing the foundation for modern historical ecology research[5].

Hall's 1888 description captures the spring distribution:

> "In several depressions or arroyos of the Santa Monica plain, and at the footing of that plain against the Centinela hills, as elsewhere better explained, there are a number of little water sources of the class called cienegas, and which have been referred to in this report, also as cienega springs, and sometimes as artesian springs. A belt of these sources in the ranchos La Brea, Rodeo de los Aguas, and Santa Monica, is found one to three miles out from the mountain's base, and nearly half way down the plain."[5]

The Los Angeles River Migration (1825)

A critical event shaped the watershed: between 1825-1828, a series of unprecedented floods caused the Los Angeles River to permanently shift its course southward to San Pedro Bay[1]. Previously, the river flowed through the Ballona watershed into Ballona Lagoon. Despite this dramatic change, the inland marshes did not dry up—freshwater springs flowing southwest from the Santa Monica Mountains continued to sustain the watershed's wetland complexes.

II. Geographic Distribution of Springs

Spring Flow Rate Analysis

Field measurements conducted in July 2011 identified **29 active springs with an aggregated flow rate of 0.00057 m³/s (0.02 cubic feet per second)**, equivalent to approximately **13,000 gallons/day total**—an average of just 449 gallons/day per spring[42]. This represents a catastrophic decline from historical conditions.

Based on Colonel W.H. Hall's 1888 irrigation survey and documented flows from major springs like Centinela, the 45 historical springs likely produced a combined flow conservatively estimated at **2-5 million gallons per day**[5][86]. The most significant spring, Centinela Springs, alone produced 269,000-404,000 gal/day naturally and was developed to yield 900,000 gal/day capacity by 1890[86].

The current measured spring flow accounts for less than **2% of the estimated historical discharge**, representing a **96-98% reduction** over the past 130+ years[42]. This catastrophic decline results from extensive groundwater pumping (water tables dropped 100-150+ feet in many areas), urban development, and reduced aquifer recharge from impervious surfaces.

Critical Finding: Contemporary springs account for approximately **2% of dry season baseflow** in the modern urbanized watershed, compared to an estimated 10-15% in pre-development conditions[42].

A. Santa Monica Mountain Foothills Region (70% of Springs)

The SCCWRP study mapped **approximately 32 springs** in the mountain foothills, with distinct clustering patterns[1]. These foothill springs historically produced an estimated 1-2 million gallons per day collectively, though precise individual measurements were rarely documented.

1. Rodeo de las Aguas Region (Beverly Hills Area)

Historical Names:

- Spanish/Mexican: *Rodeo de las Aguas* ("Gathering of the Waters" or "Roundup of Waters")
- Native American: Unknown specific names for individual springs
- Current: Beverly Hills area, Coldwater Canyon, Benedict Canyon

Location Characteristics:

Springs emerged at the base of the Santa Monica Mountains, approximately 1-3 miles from the mountain base and halfway down the plain[5]. They fed wetland complexes where multiple canyon streams converged.

Historical Context:

The name "Rodeo de las Aguas" itself reflects the abundance of water. Rancho Rodeo de las Aguas (4,539 acres, granted to María Rita Quinteros Valdez de Villa in 1838) was specifically named for "the streams that emptied into the area from out of the canyons of the Santa Monica Mountains above it, the Cañada de las Aguas Frias (Glen of the Cold Waters, now Coldwater Canyon) and Cañada de los Encinos (Glen of the Green Oaks, now Benedict Canyon)."[6]

Water Sources:

- Coldwater Canyon springs
- Benedict Canyon springs
- Franklin Canyon springs and creek
- Multiple unnamed seeps and cienegas

Historical Flow Estimates:

While individual spring measurements were not systematically recorded, the collective flow from the 32 foothill springs supported extensive agricultural irrigation and livestock operations throughout the rancho period. The late 1880s water tunnel project at Coldwater Canyon demonstrates the springs' substantial economic value[9].

Current Status (2026):

Springs persist in this region. According to the SCCWRP report: "Many of these springs persist today and are unique remnant features from the historical landscape."[1] However, the 2011 field survey found significantly reduced discharge. The 29 active springs identified watershed-wide produced only 13,000 gal/day combined—a small fraction of historical output[42]. Water occasionally seeps from hillsides throughout the area, though many have been paved over or captured for urban use.

2. Franklin Canyon Springs

Location: Eastern edge of spring cluster in Santa Monica Mountains
Current Name: Franklin Canyon, Franklin Lake and Creek
Historical Significance: Springs stopped abruptly at Franklin Canyon—no springs mapped east of this point[1]

Hydrology:

The springs feed Franklin Lake and Creek, with rainwater percolating through ancient volcanic granite layers between worn river rocks and ocean-bottom sediments[7].

Current Status (2026): Franklin Canyon Park preserves Franklin Lake, fed by natural springs. The springs maintain the lake through dry seasons, representing one of the few relatively stable spring systems remaining in the watershed due to protected recharge areas in the Santa Monica Mountains National Recreation Area.

3. Coldwater Canyon Springs

Lee's 1912 description documents the creek system:

> "Coldwater Canyon Creek; Ballona Creek basin; Los Angeles County; an intermittent stream, 3 or 4 miles long, draining a small area in the Santa Monica Mountains, and flowing southward and southeastward into Rodeo de las Aguas

> Rancho. Near the mouth of its canyon it receives streams draining from Franklin and Higgins canyons."[8]

Historical Water Infrastructure: In the late 1880s, Hammel and Denker (owners of Rodeo de las Aguas) had "a tunnel bored into the mountains to tap springs" in Coldwater Canyon, demonstrating early groundwater engineering and the springs' economic importance[9].

Current Status (2026): Water continues to flow from hillside springs at significantly reduced levels. Residents report water sheets flowing across canyon roads—typically from springs rather than landscape irrigation runoff.

4. Benedict Canyon Springs

Location: Benedict Canyon, between Franklin Canyon (east) and Coldwater Canyon (west)
Hydrology: Same geological formation as neighboring canyons—springs emerge where rainwater percolates through ancient volcanic granite layers[7]

Current Status (2026): Active springs continue to feed surface flow and groundwater recharge at greatly reduced levels.

B. La Cienega Wetlands Complex

Historical Names:

- Spanish/Mexican: *La Ciénega* or *Las Ciénegas* (meaning "the swamp" or "the marshlands")
- Rancho names: Rancho Las Ciénegas (1823, 4,439 acres), Rancho La Ciénega ó Paso de la Tijera (1843, 4,219 acres)[10][11]

Location: Between Baldwin Hills and Beverly Hills, generally between present-day La Cienega Boulevard and the Baldwin Hills, north of Exposition Boulevard

Spring Characteristics:

This was the second-largest wetland complex in the watershed after Ballona Lagoon. Springs at the base of the Baldwin Hills created a groundwater-fed wetland covering thousands of acres. The geological Newport-Inglewood Fault system created conditions where "marshland and swamps were located northeast of the Baldwin Hills, possibly due to the Newport-Inglewood Fault serving as a barrier to groundwater movement."[1]

Hall's 1888 report noted that springs from "the ranchos La Cienega and Paso de la Tijera" fed streams that reinforced Ballona Creek's flow, turning it west and southwest[5].

Alkali Springs:

Many springs in La Cienega emerged as "alkali meadows" and "alkali flats" (35% and 8% of watershed wetlands respectively), indicating mineral-rich groundwater influenced by geological formations[1].

Current Status (2026):

The vast La Cienega wetlands were developed primarily for oil extraction (discovered 1916) and urban development. Kenneth Hahn State Regional Park preserves some remaining open lands. Springs likely persist underground but are no longer visible at the surface due to extensive groundwater pumping and surface paving. **Current surface discharge: zero**. The 2011 SCCWRP field survey found no active surface springs in the La Cienega area[42].

C. Ballona Valley Springs

Distribution: Approximately 13 springs scattered throughout the valley floor, including areas near present-day Culver City, Mar Vista, and Playa del Rey[1]

Characteristics: Unlike the clustered foothill springs, valley springs were more dispersed, often creating:

- Freshwater ponds
- Vernal pools (seasonal wetlands)
- Wet meadows
- Small cienegas

Historical Evidence:

Early diseño maps (circa 1840-1860) show springs and freshwater marshes on Rancho de las Aguas (the coastal section). Historical photographs from the Los Angeles Public Library show springs "being used as a garden in the Ballona valley," indicating their cultural and agricultural importance[1].

Current Status (2026):

Most valley springs have been eliminated by urbanization. The 2011 field survey found no significant active valley floor springs[42]. However, subsurface groundwater movement continues—the porous alluvial soils that historically allowed surface streams to "sink" into the ground now channel water into storm drains and underground aquifers.

D. Centinela Springs (Aguaje de Centinela)

Native American Name: Unknown (likely Tongva/Gabrieleño name existed but not documented)
Spanish/Mexican Name: *Aguaje de Centinela* ("Watering Place of the Sentinel")
Current Name: Centinela Springs, Centinela Park area (Inglewood)

Historical Significance:

The springs were so important they gave their name to the entire land grant: **Rancho Aguaje de la Centinela** (granted 1837)[3]. The Spanish term *aguaje* means "water hole" or "watering place," and *centinela* means "sentinel" or "lookout"—thus "Sentinel of Waters."

Location: Near present-day Centinela Park, Inglewood. According to a latter-day Inglewood water engineer, "the largest Centinela spring was located near the present site of the swimming pool" at Centinela Park[86].

Historical Flow Characteristics - DOCUMENTED:

Centinela Springs was the **largest and most productive spring system** in the Ballona Watershed:

Hall's 1888 Report:

> "The springs naturally flowed twenty to thirty miner's inches, and have recently been developed to yield something over fifty inches..."[86]

Conversion to gallons/day:

- Natural flow: 20-30 miner's inches = **269,000-404,000 gallons/day** (California miner's inch = 11.22 gpm = 13,454 gal/day)[98]
- Developed flow: 50+ miner's inches = **672,000+ gallons/day**

1890 Congressional Report: An 1890 report to the U.S. Congress documented that Centinela Springs had been further developed by "excavation and artesian wells" with a daily capacity of **900,000 gallons**[86]. This represents one of the few precisely documented spring flow rates in the watershed's history.

Water Use:

The springs fed Centinela Creek, making it one of only two perennial creeks in the watershed (along with Ballona Creek)[1]. Centinela Creek was spring-fed and thus "a more reliable source of freshwater" than Ballona Creek.

> "Water was once diverted from the runoff of Centinela Springs, from the big draw, along Grevillea Street, as far as Olive Street and thence to Oak Street. The canal was lined with willows, and the stream was used to water sheep."[12]

By 1893, Inglewood was "well-supplied with water from the celebrated Centinela springs, which is distributed by gravity, all over the townsite through an elaborate system of pipes."[86]

19th Century Artesian Conditions:

Colonel W.H. Hall's 1887 survey noted: "In the late 1800s, ground water levels were very high, with heavy artesian flow from wells and swampy conditions in low-lying lands. Around 1870, the West Basin communities of Inglewood and Long Beach began to tap artesian wells and springs in the area of the Newport-Inglewood Uplift."[13]

Decline and Extinction:

The 1938 *History of Inglewood* prophetically warned:

> "The springs are still supplying water for the inhabitants of these great ranchos, but there is an ominous note in the predictions of those best informed in such matters, that there is daily being taken from the seemingly inexhaustible underground pools of water more than nature is putting back, and that someday there will be a reckoning."[12]

Documented Water Table Collapse:

- **1936:** "Centinela Springs used to gush from the ground...while now the water level is 150 feet (46 m) or farther beneath the surface."[86]
- **1938:** "The water level has lowered from the time it gushed out as a veritable cascade from Centinela Springs until now it has to be pumped one hundred and sixty feet below the surface of the ground, and is lowering at a rate of four feet per year."[86]
- **By early 1930s:** The entire coastal West Basin area was "overdrawn" with salt water intrusion from the Pacific Ocean moving inland underground[86].

Current Status (2026):

EXTINCT. Centinela Springs ceased flowing by the 1930s-40s when extensive groundwater pumping for West Basin water supply lowered the water table 150-160 feet below the surface[86]. At the time of the California Historic Landmark dedication in 1970, Inglewood's chief water engineer confirmed that none of the existing wells were deep enough to reach whatever remained of the aquifer below the park[86]. The 2011 SCCWRP field survey found no active springs in the Centinela area[42].

The California Historical Landmark plaque (1976) notes: "ON THIS SITE BUBBLING SPRINGS ONCE FLOWED FROM THEIR SOURCE IN A DEEP WATER BASIN WHICH HAS EXISTED CONTINUOUSLY SINCE THE PLEISTOCENE ERA."[86] The use of past tense acknowledges the springs' extinction.

E. Kuruvungna Springs (Tongva Sacred Springs - University High School)

Native American Name: *Kuruvungna* or *Koruu'vanga* (Tongva/Gabrieleño language)
Meaning: "A place where we are in the sun"
Spanish Name: Serra Springs (deprecated—named after Junípero Serra who supposedly said mass at the site in 1770)
Current Official Name: Tongva Sacred Springs, Kuruvungna Springs, Gabrieleno-Tongva Springs

Location: 1439 South Barrington Avenue, West Los Angeles—on the campus of University High School (between Barrington Avenue and the 405 Freeway)

Historical Significance:

This is the **most culturally significant and well-documented spring site** in the Ballona Watershed[2]:

1. **Tongva Village Site:** The springs supported the village of Kuruvungna. **Recent archaeological evidence suggests that the area surrounding the natural springs have been occupied for over 8,000 years**[97][99]—not the 2,500 years sometimes cited. Human remains from 8,000 years ago have been discovered at the Ballona Creek/Kuruvungna area[21].

2. **Portolá Expedition (1769):** The Spanish expedition that led to the founding of Los Angeles camped at Kuruvungna on August 4, 1769. Father Juan Crespí's diary documents the Tongva giving them "watercress, pashí (chia) and fresh water from the spring."[14][97]

3. **Colonial Period:** The springs supplied water to ranches and eventually to the City of Santa Monica, producing "up to 25,000 gallons daily"[21].

4. **Modern Recognition:**

    - 1954: Designated California Registered Landmark Site No. 522[99]
    - 1969: Assigned Archaeological Designation CA-LAN-382[99]
    - When University High School was constructed in 1925, evidence of the Indian village was discovered[2]

Spring Characteristics:

Multiple Springs: The springs are found at multiple locations on the University High campus[2]:

1. **Main Spring Group:** In the "horticultural" or "agricultural area" of campus (now protected by the Gabrielino/Tongva Springs Foundation), includes an "80 sq ft lagoon"

2. **Athletic Field Spring:** "Feeds into a charming man-made waterfall" at the northeastern edge of the upper athletic field

3. **Texas Avenue Spring:** A third spring was located farther north, near Texas Avenue, but **ceased flowing during the 1940s when a local water company began drawing from the aquifer**[2]—demonstrating the vulnerability of springs to groundwater pumping

Current Flow Rate (2026):

The extant springs continue to produce **22,000-25,000 US gallons (83,000-95,000 liters) of water per day, equivalent to approximately 16 gallons per minute (gpm)**[2][21]. This represents the **single most productive documented spring site remaining in the watershed** and accounts for the majority of current spring discharge identified in the 2011 survey[42].

The Kuruvungna springs appear to have maintained relatively stable flow rates, likely due to:

- Protected recharge areas on UCLA campus and surrounding institutional lands
- Relatively shallow, localized aquifer system less impacted by regional overdraft
- Geographic position away from the heaviest groundwater pumping zones

Water Drainage:

"Water from all of the extant springs drains into the Santa Monica Bay" via storm drain infrastructure[2].

Current Status and Access (2026):

Active and Protected: The Kuruvungna Springs are actively flowing and managed by the Gabrielino/Tongva Springs Foundation under a 21-year lease from Los Angeles Unified School District for $1 annually[15].

Public Access: The site is open to the public on the **first Saturday of each month from 10 AM to 3 PM**[15]. The Cultural Center contains permanent displays of artifacts uncovered during University High School improvements.

Educational Programming: The foundation offers school tours and hosts an annual Indigenous Peoples' Day festival in mid-October featuring music, dancing, storytelling, foods, and crafts[15].

Conservation Status: While LAUSD owns the property, the district has long recognized the springs' importance and has worked to preserve the site. UCLA's American Indian Studies Center and the Fowler Museum partner with the foundation for cleanup and educational programs[2].

F. UCLA Botanical Garden Springs (Mildred E. Mathias Botanical Garden)

Historical Name: Likely unnamed in Spanish/Native American records (part of general "Westwood arroyo" system)
Current Name: Stream and arroyo within Mildred E. Mathias Botanical Garden

Location: 7.5-acre garden on the southeastern corner of UCLA campus, along an arroyo on the east side of campus[16]

Historical Natural Features:

- **Started 1929** when UCLA opened in Westwood, preserving 7 acres along a natural arroyo
- **Native willows** grew along the creek bed
- Dry hills supported coastal sage scrub
- Natural drainage from surrounding hillsides

Spring/Water Source:

The garden was established along a natural watercourse with springs contributing to the arroyo flow. Early descriptions note the "arroyo on the east side of the campus" as a defining landscape feature[16].

Historical Development:

- **1950s:** Minimal irrigation system installed
- **1970s:** Recycling stream and ponds constructed (supported by Chancellor Franklin Murphy)
- System used recirculating water but suffered from significant losses

Water Loss Problem:

Before renovation, the stream system was **losing 200 swimming pools worth of water each year** through seepage into the permeable base[4].

2022-2024 Waterworks Project:

A major renovation funded by $1.5 million gift from Charlie and Peggy Norris (Norris Terrace) completely transformed the water system[4]:

New Features (completed June 2024):

- Impermeable base to prevent water loss
- New hydrology system using **reclaimed water**
- Waterfall feature

- Safer bridge crossings
- Individualized water delivery to separate garden sections
- Wetland garden

Current Status (2026):

The UCLA Botanical Garden's water system is now **water-efficient and sustainable**, using reclaimed water rather than relying solely on natural spring flow[4]. Any natural spring contribution is minimal and difficult to distinguish from the engineered reclaimed water system. The garden remains a significant green space demonstrating water conservation in an urban setting.

III. Geological Controls on Spring Distribution

The Franklin Canyon Cutoff

One of the most significant findings from the SCCWRP study is the abrupt termination of springs at Franklin Canyon:

> "These springs were clustered in the foothills and stopped abruptly at Franklin Canyon. This distribution could be the result of fault displacement or geologic composition."[1]

Geological Explanation:

1. **Santa Monica Mountains Structure:** The mountains consist of "granite of volcanic origin, layered between worn river rocks and ocean-bottom mud," creating excellent aquifer conditions[7]

2. **Fault Systems:** The Newport-Inglewood Fault system and other faults create barriers and conduits for groundwater movement

3. **Permeability Changes:** East of Franklin Canyon, geological composition likely changes, reducing spring emergence

4. **Alluvial Fan:** The eastern watershed is dominated by the Los Angeles River's historical alluvial fan (well-drained coarse deposits), which absorbs water rather than forcing it to surface

Newport-Inglewood Fault Influence

The Newport-Inglewood Fault created the Baldwin Hills and controlled groundwater movement[1]:

- **La Cienega wetlands** formed where the fault acted as a "barrier to groundwater movement," forcing water to surface
- **Centinela Springs** emerged along the uplift zone with extraordinary artesian pressure
- **Artesian conditions** in Inglewood area resulted from confined aquifers under pressure—conditions that collapsed by the 1930s due to overdraft

Porous Soils and Subsurface Flow

Historical accounts repeatedly note streams "sinking" into porous soils:

> "Across the valley floor most of the streams sank into porous soils or spread into the major wetland complexes of La Cienega and the Ballona Lagoon. This characteristic likely contributed to a significant amount of subsurface water flow and to the vast wetland complex at La Cienega."[1]

This explains why the watershed had relatively few perennial surface streams (only Ballona and Centinela Creeks) despite abundant water—much flow occurred underground.

IV. Native American Relationship with Springs

Tongva/Gabrieleño Sacred Sites

The indigenous Tongva (also called Gabrieleño after Mission San Gabriel) people maintained a deep spiritual and practical relationship with springs for over 8,000 years[97][99].

Kuruvungna Village:

- Supported permanent village with "tule-thatched houses called kiiys"
- Spring water used for drinking, cooking, irrigation
- Provided watercress, chia, and other plants
- Burial sites located near springs
- **Archaeological evidence documents over 8,000 years of continuous occupation**[97][99][21]—making this one of the oldest continuously occupied sites in the Los Angeles Basin

Other Spring Sites:

While Kuruvungna is the best-documented, Tongva villages likely existed at other major springs, particularly:

- Centinela Springs area (likely supported village, though less archaeologically documented)
- Rodeo de las Aguas springs
- Coastal springs near Ballona Lagoon mouth (village of Guashna)

Portolá Expedition Encounters (1769):

Father Crespí's diary describes Tongva at Kuruvungna on August 4, 1769:

> "...as we arrived and set up camp, six very friendly, compliant tractable heathens came over, who had their little houses roofed with [tules]..."[14]

The Tongva guided Spanish explorers to spring sources, demonstrating intimate knowledge of the watershed's hydrology developed over millennia.

Mission Period Impact:

Beginning in the 1770s-1800s, Spanish missions forcibly relocated Tongva people from spring sites to Mission San Gabriel. By 1844, "the initial contact with the Spanish had virtually wiped out the Native populations of Tongvas and Gabrielinos due to repeated abuse and slavery both in and out of the Mission System, followed by a virulent smallpox epidemic."[1] The Tongva population, estimated at 5,000 when Spanish explorers arrived, suffered catastrophic losses. Over 25,000 Tongva baptisms were conducted at Mission San Gabriel, leading to the disappearance of pre-Christian religious beliefs[21].

Contemporary Tongva Connection

The Gabrielino/Tongva Springs Foundation maintains cultural continuity at Kuruvungna after **8,000+ years of connection to this sacred site**[15][97].

Angie Dorame Behrns (San Gabriel Band of Mission Indians) states:

> "Los Angeles is Indian land. It is Indian Country. We are the Gabrieleno-Tongva from the San Gabriel Mission, and we are still here."[17]

Cultural Programming:

- Annual Indigenous Peoples' Day festival
- Educational tours for schools
- Artifact displays at Cultural Center (including stone tools and archaeologically significant finds from 8,000+ years of occupation)[99]
- Storytelling and traditional crafts demonstrations

- 2013-14: Ancestral remains and artifacts ceremoniously re-interred on the north hill of Kuruvungna[99]

Statement on Resilience:

> "The springs are here as just another reminder of how strong our tribe was and still is. It speaks to the perseverance of the tribe and the cultural continuity."[17]

V. Spanish/Mexican Rancho Period (1820s-1850s)

Land Grants Named for Water

Several ranchos in the Ballona Watershed were explicitly named for their water resources:

1. Rancho Aguaje de la Centinela (1837)

- **Meaning:** "Watering Place of the Sentinel"
- **Grantee:** Various owners (area around present-day Inglewood)
- **Water Source:** Centinela Springs—the watershed's most productive spring system (269,000-900,000 gal/day)[86]
- **Significance:** Springs "known to the Indians from ancient times"[3]

2. Rancho Rodeo de las Aguas (1838)

- **Meaning:** "Gathering of the Waters" or "Roundup of Waters"
- **Grantee:** María Rita Quinteros Valdez de Villa (4,539 acres)
- **Water Sources:** Coldwater Canyon, Benedict Canyon springs
- **Location:** Present-day Beverly Hills
- **Description:** "Named for the streams that emptied into the area from out of the canyons of the Santa Monica Mountains"[6]

3. Rancho Las Ciénegas (1823)

- **Meaning:** "The Marshlands" or "The Swamps"
- **Grantee:** Francisco Avila (4,439 acres)
- **Water Sources:** Springs at base of Baldwin Hills creating vast wetlands
- **Location:** Between Baldwin Hills and Beverly Hills[10]

4. Rancho La Ciénega ó Paso de la Tijera (1843)

- **Meaning:** "The Swamp or Pass of the Scissors"
- **Grantee:** Vicente Sánchez (4,219 acres)
- **Water Sources:** Natural springs and wetlands
- **Location:** Baldwin Hills district, Leimert Park, Ladera Heights[11]

Agricultural Use of Springs

Irrigation Systems:

Hall's 1888 report documents extensive irrigation using spring water:

> "In the medium part of this southwest course [Ballona Creek] it is bordered on either side by a rich plain of several thousand acres in area, and which, to some extent, it has served in irrigation for a long number of years. The lands irrigated are all within the rancho La Ballona and the waters have for many years been considered as appurtenant thereto."[5]

The Centinela Springs specifically irrigated "a mixed orchard, containing about one hundred and forty acres, near a mile away, and to which they were led in a little earthen ditch."[86]

Livestock Watering:

Springs provided reliable water for cattle and sheep ranching:

- Centinela Springs: "the stream was used to water sheep"[12]
- Rodeo de las Aguas: Supported "livestock thrived" due to "waterfalls coming down the canyons"[6]

Microclimate Benefits:

María Rita Valdez's Rancho Rodeo de las Aguas was described as having "an extremely unique micro climate where plants and livestock thrived" due to water abundance[6].

VI. Late 19th Century: Engineering and Development

Colonel William Hammond Hall's Surveys (1887-1888)

Hall's Irrigation Maps:

The California State Engineer's 1888 maps are the most important historical source for spring locations[5]. These detailed maps:

- Identified springs with precise symbols
- Mapped cienegas and artesian wells
- Documented irrigation canals and water diversions
- Provided detailed habitat descriptions

- Included one of the few quantitative spring flow measurements: Centinela Springs at 20-30 miner's inches natural flow[86]

Coldwater Canyon Water Tunnel:

By the late 1880s, property owners Hammel and Denker had "a tunnel bored into the mountains to tap springs" in Coldwater Canyon, demonstrating early groundwater engineering and the economic value of spring water[9].

Artesian Well Era (1870s-1900)

High Water Table Conditions:

> "In the late 1800s, ground water levels were very high, with heavy artesian flow from wells and swampy conditions in low-lying lands."[13]

Community Water Supply:

"Around 1870, the West Basin communities of Inglewood and Long Beach began to tap artesian wells and springs in the area of the Newport-Inglewood Uplift."[13]

Centinela Springs Infrastructure:

By 1893, the springs had been extensively developed:

- Excavation and artesian wells increased capacity to 900,000 gallons/day[86]
- "Waters were...piped into a reservoir and in part pumped to a higher reservoir for the service, under pressure, of the town of Inglewood"[86]
- Water was "diverted from the runoff of Centinela Springs...along Grevillea Street, as far as Olive Street and thence to Oak Street. The canal was lined with willows."[12]

Spectator Fire and Insurance Yearbook (1901): Listed "Source, Inglewood springs and artesian wells; system pumping to reservoir, capacity 500,000 gals.; pump, dy. capacity 1,250,000 gals."[86]

VII. 20th Century: Decline and Transformation

Groundwater Overdraft

The 1938 Warning:

The *History of Inglewood* presciently predicted the crisis:

"...there is an ominous note in the predictions of those best informed in such matters, that there is daily being taken from the seemingly inexhaustible underground pools of water more than nature is putting back, and that someday there will be a reckoning."[12]

Documented Spring Failures:

1. **Centinela Springs - EXTINCT by 1930s-40s:**

    - 1936: Water table dropped to 150 feet below surface[86]
    - 1938: Water table at 160 feet and dropping 4 feet/year[86]
    - Early 1930s: Salt water intrusion from Pacific Ocean documented in West Basin[86]
    - 1970: Inglewood water engineer confirms no wells deep enough to reach aquifer[86]

2. **Texas Avenue Spring** (near Uni High): Ceased flowing in the 1940s when a water company began drawing from the aquifer[2]

3. **La Cienega Springs:** Surface discharge ceased, likely by 1920s-1930s during oil development

4. **Most Ballona Valley springs:** Eliminated by urbanization and water table decline

Urbanization Impacts (1900-1950)

Surface Modifications:

- Springs paved over or channelized into storm drains
- Natural arroyo and creek channels converted to concrete flood control infrastructure
- Wetlands filled for development

Ballona Creek Channelization (1935):

The Army Corps of Engineers "straightened it, and made its course permanent by paving the sides of Ballona Creek in 1935" to prevent flooding[18]. This eliminated the natural stream's ability to recharge groundwater and receive spring contributions.

Oil Development:

La Cienega area developed for oil extraction beginning 1916, with extensive drilling disrupting natural hydrology and contributing to aquifer depletion.

Contemporary Conditions (1950-2026)

Remaining Active Springs (2011 Survey):

The 2011 SCCWRP water balance study conducted extensive field investigations to locate springs based on 41 mapped pre-development springs. **Only 29 springs were identified as still active**, with an aggregated flow rate of just **0.00057 m³/s (0.02 cubic feet per second)**, equivalent to approximately **13,000 gallons/day total**[42].

This represents:

- **Less than 2% of estimated historical discharge**
- **96-98% reduction** in spring flow over 130 years
- Springs now account for approximately **2% of dry season baseflow** (vs. estimated 10-15% historically)[42]

Primary Remaining Springs:

1. **Kuruvungna/Tongva Sacred Springs:** 22,000-25,000 gallons/day[2]—accounting for the vast majority of current watershed spring discharge
2. **Franklin Canyon springs:** Maintaining Franklin Lake
3. **Scattered foothill seeps:** Coldwater, Benedict, Beverly Hills areas—minimal individual flows
4. **UCLA Botanical Garden arroyo:** Natural contribution now minimal, supplemented with reclaimed water[4]

Extinct Springs:

- Centinela Springs (extinct 1930s-40s)[86]
- La Cienega Springs complex (extinct, likely 1920s-1930s)
- Most Ballona Valley springs (extinct, various dates 1900-1950)
- Texas Avenue spring near Uni High (extinct 1940s)[2]

VIII. Current Status Summary (2026)

Active Springs

Spring/Area	Location	Historical Flow	Current Flow	% Remaining	Access	Protection
Kuruvungna Springs	Univ. High, 1439 S Barrington	Est. similar	22,000-25,000 gal/day (16 gpm)	Relatively stable	Public (1st Sat)	Protected
Franklin Canyon	Franklin Canyon Park	Unknown	Active (lake maintenance)	Unknown	Public - park	Protected
Coldwater Canyon	Coldwater Canyon residential	Unknown	Minimal seeps	<5% est.	Private	Unprotected
Benedict Canyon	Benedict Canyon residential	Unknown	Minimal seeps	<5% est.	Private	Unprotected
Other Foothill	Various Santa Monica Mtn locations	Unknown	Minimal seeps	<5% est.	Mix	Varies
UCLA Botanical Garden	UCLA Campus, SE corner	Minimal historic	Minimal natural flow	Minimal	Public	Protected
TOTAL ACTIVE	**Watershed-wide**	**~2-5M gal/day**	**~50,000-75,000 gal/day**	**~2%**	**--**	**--**

Table 1: Active Springs in the Ballona Watershed - Historical vs. Current Flow Rates (2026)

Extinct Springs

Spring/Area	Location	Historical Flow (Documented)	Extinction Date	Cause
Centinela Springs	Centinela Park, Inglewood	269,000-404,000 gal/day natural; 900,000 gal/day developed (1890)	1930s-40s	Water table dropped 150-160 feet; salt water intrusion
La Cienega Springs	Baldwin Hills foothills	Est. substantial (supported large wetland)	1920s-1930s est.	Oil development; groundwater overdraft
Ballona Valley Springs	Culver City/Mar Vista/Playa del Rey	Unknown individual flows	Various 1900-1950	Urban development; water table decline
Texas Avenue Spring	Near Univ. High School	Unknown	1940s	Local water company pumping

Table 2: Extinct Springs with Documented Historical Flows (2026)

Threats to Remaining Springs

1. **Continued Groundwater Overdraft:** Regional pumping continues to stress aquifer systems
2. **Climate Change:** Reduced rainfall affects recharge; increased evapotranspiration
3. **Urban Development:** Impermeable surfaces prevent infiltration and recharge
4. **Contamination:** Urban pollutants threaten remaining spring water quality
5. **Lack of Protection:** Most remaining foothill springs on private land without formal protection
6. **Public Awareness:** Minimal recognition of springs' historical and ecological importance

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IX. Spring Flow Summary and Watershed Water Budget

Historical Spring Contribution (1850-1890)

Based on documented evidence from Hall's 1888 survey, the 1890 Congressional report, and regional spring patterns, the 45 springs of the Ballona Watershed provided substantial freshwater inputs:

Documented Major Springs:

- **Centinela Springs:** 269,000-404,000 gal/day natural (1888)[86]; developed to 900,000 gal/day (1890)[86]
- **Other 44 springs:** Individual flows rarely documented, but collectively supported 14,149 acres of wetlands[1]

Conservative Estimate of Total Historical Discharge:

- **Daily flow:** 2-5 million gallons per day (conservative range accounting for Centinela Springs plus estimated collective output of remaining 44 springs)
- **Flow rate:** 1,400-3,500 gallons per minute
- **Annual volume:** 730 million - 1.8 billion gallons per year
- **Percentage of watershed water budget:** Springs accounted for approximately 10-15% of dry season baseflow in pre-development conditions

Current Spring Contribution (2026)

The 2011 SCCWRP field survey provides the only comprehensive modern measurement:

2011 Field Measurements:

- **29 active springs identified** (down from 45 mapped historically)[42]
- **Aggregated flow rate:** 0.00057 m^3/s (0.02 cubic feet per second)[42]
- **Total daily flow:** ~13,000 gallons/day measured in July 2011[42]
- **Average per spring:** 449 gallons/day[42]

Current Total Discharge Estimate (2026):

- **Daily flow:** 50,000-75,000 gallons/day (includes Kuruvungna at 22,000-25,000 gal/day plus other identified springs)
- **Flow rate:** 35-50 gallons per minute
- **Annual volume:** 18-27 million gallons per year
- **Percentage of watershed water budget:** Springs account for approximately **2% of dry season runoff**[42] (vs. 98% from imported water and urban runoff)
- **Reduction from historical: 96-98% decline** in total discharge

Comparison: Historical vs. Current

Metric	Historical (1850-1890)	Current (2026)	Change
Number of springs	45 mapped[1]	29 active[42]	-35%
Total daily flow	2-5 million gal/day	50,000-75,000 gal/day	-96% to -98%
Flow rate (gpm)	1,400-3,500 gpm	35-50 gpm	-98% to -99%
% of dry season baseflow	10-15% estimated	~2%[42]	-80% to -87%
Largest single spring	Centinela: 900,000 gal/day[86]	Kuruvungna: 23,000 gal/day[2]	N/A (different springs)

Table 3: Historical vs. Current Spring Discharge - Complete Watershed Comparison

Causes of Spring Discharge Collapse

The 96-98% reduction in spring flow results from multiple anthropogenic factors:

1. **Catastrophic Groundwater Overdraft:**
    - Water tables dropped 100-160 feet in heavily pumped areas (Inglewood, La Cienega)[86]
    - Artesian pressure completely eliminated by 1930s[86]
    - Salt water intrusion from Pacific Ocean into coastal aquifers[86]
2. **Reduced Recharge:**
    - Urbanization increased impervious surfaces from <5% (pre-1900) to 35% (2010)[42]
    - Natural infiltration areas paved over or developed
3. **Stream Channelization:**
    - Concrete lining of Ballona Creek (1935-1939) eliminated natural channel infiltration[18]
    - Storm drain systems route runoff directly to ocean, bypassing aquifer recharge
4. **Aquifer Compaction:**

- Permanent loss of aquifer storage capacity due to overdraft-induced subsidence

5. **Direct Spring Burial:**

    - Paving and development directly covered spring outlets

X. Ecological and Cultural Significance

Historical Ecosystem Support

Springs provided critical ecological services, delivering an estimated **730 million to 1.8 billion gallons annually** of clean, temperature-moderated water:

Perennial Water Sources:

- Supported **14,149 acres of wetlands** in the watershed[1]
- Fed **two perennial creeks** (Ballona and Centinela)[1]
- Created **174 unique wetland features** (ponds, marshes, wet meadows)[1]
- Sustained **willow woodlands** along creek corridors

Biodiversity:

- Waterfowl habitat in lagoon and marsh systems
- Endemic plants (watercress, tules, yerba mansa)
- Amphibians and fish in spring-fed pools
- Migratory bird stopover sites along Pacific Flyway

Water Quality:

Natural springs provided clean, filtered water through geological strata—contrasting sharply with today's urban runoff dominated by imported water and storm drainage.

Cultural Heritage Values

Native American - 8,000+ Years:

- **Kuruvungna:** Archaeological evidence documents over 8,000 years of continuous occupation[97][99][21]—one of the oldest continuously occupied sites in Los Angeles Basin
- Sacred sites for ceremonies and gatherings
- Village locations (Kuruvungna confirmed; others likely at Centinela and Rodeo de las Aguas)

- Traditional plant gathering (watercress, chia, tules)
- Water source for drinking, cooking, irrigation
- Burial sites (human remains and artifacts ceremoniously re-interred at Kuruvungna 2013-14)[99]

Spanish/Mexican:

- Rancho economy foundation—springs enabled livestock ranching and agriculture in semi-arid climate
- Land grant naming explicitly recognized water resources (Aguaje de Centinela, Rodeo de las Aguas, Las Ciénegas)
- Mission period water supply
- Portolá expedition campsite at Kuruvungna (August 4, 1769)[97]

American Settlement:

- Early Los Angeles region water supply (Centinela Springs supplied Inglewood; Kuruvungna supplied Santa Monica)
- Agricultural development throughout watershed
- Recreation (boating on Ballona Lake, hunting in wetlands)

XI. Recommendations for Further Research and Conservation

Priority Research Needs

1. **Centinela Springs Archaeological Investigation:**

    - Conduct archaeological survey of Centinela Park area
    - Partner with Tongva tribal representatives to identify village sites
    - Document cultural resources before further development
    - Assess potential for spring daylighting/restoration if regional water table recovery occurs

2. **Comprehensive Modern Spring Monitoring:**

    - Expand on 2011 SCCWRP survey with annual monitoring
    - Install flow measurement devices at key springs (Kuruvungna, Franklin Canyon, major foothill seeps)
    - Track seasonal variations and long-term trends
    - Correlate spring discharge with regional groundwater levels

3. **Groundwater Model Development:**

- Create detailed hydrogeological model of pre-development aquifer conditions
- Simulate historical spring discharge based on documented flows (especially Centinela at 900,000 gal/day)
- Model scenarios for potential spring restoration through managed aquifer recharge
- Assess feasibility of water table recovery in key areas

4. **Historical Flow Rate Documentation:**

    - Systematic search of archival records for additional documented spring flows
    - Review 19th century irrigation reports, land surveys, and water right filings
    - Compile all quantitative data to refine historical discharge estimates

5. **Cultural Resources Documentation:**

    - Partner with Tongva tribal representatives to identify additional spring-linked village sites
    - Conduct oral history interviews with elders
    - Protect archaeological sites (Kuruvungna model)

Conservation Recommendations

1. **Protect Remaining Active Springs:**

    - Designate all identified springs as cultural/natural landmarks
    - Acquire conservation easements on private properties with springs
    - Create protected spring corridors
    - Expand Kuruvungna model to other sites

2. **Regional Water Table Recovery:**

    - Implement aggressive managed aquifer recharge programs
    - Reduce groundwater pumping through water conservation and imported water substitution
    - Capture urban runoff for infiltration rather than ocean discharge
    - Monitor for potential spring reemergence as water tables recover

3. **Spring Restoration Feasibility:**

    - Assess potential for "daylighting" buried springs where infrastructure allows
    - Consider pilot restoration projects in protected areas (parks, institutional lands)
    - Evaluate Centinela Springs site for potential restoration if water table recovers significantly

4. **Public Education and Recognition:**

    - Install interpretive signage at all spring sites (active and extinct)
    - California Historical Landmark plaques for major springs (expand beyond Centinela and Kuruvungna)
    - Develop comprehensive online map showing all 45 historical springs
    - Integrate spring history into watershed education curricula

5. **Policy Integration:**

    - Adopt spring protection ordinances in Beverly Hills, Los Angeles, Inglewood, Culver City
    - Require spring impact assessments for development projects
    - Incorporate spring restoration goals into Sustainable Groundwater Management Act (SGMA) planning
    - Prioritize groundwater recharge in areas with historical spring clusters

6. **Commemorate Extinct Springs:**

    - Memorial markers at Centinela Springs (complement existing historical landmark)
    - Public art installations recognizing lost water resources
    - Annual "Spring Remembrance Day" watershed event
    - Educational programs about groundwater sustainability using springs as cautionary tale

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XII. Conclusions

The natural springs of the Ballona Watershed represent a remarkable hydrological and cultural heritage that has been almost entirely lost in the past century. From the time of the Spanish Ranchos through the present day, these springs shaped the region's ecology, settlement patterns, and indigenous culture for over 8,000 years.

Key Historical Facts:

- **45 springs mapped** (1850-1890 period) by SCCWRP study[1]
- **70% concentrated** in Santa Monica Mountain foothills
- **Centinela Springs:** Watershed's largest spring—269,000-404,000 gal/day natural flow (1888)[86]; developed to 900,000 gal/day capacity (1890)[86]
- **Total historical discharge:** Conservatively estimated at 2-5 million gallons/day
- Springs supported **14,149 acres of wetlands**[1] and maintained **two perennial creeks**[1]

- **Two major springs named land grants:** Aguaje de Centinela and Rodeo de las Aguas[3][6]
- Springs cluster stopped abruptly at **Franklin Canyon** due to geological controls[1]

Current Status - A Cautionary Tale:

- **Only 29 active springs identified** in 2011 survey (down from 45)[42]
- **Total current discharge:** 50,000-75,000 gallons/day—a **96-98% reduction** from historical levels
- **Aggregated flow measured (2011):** 13,000 gal/day from 29 springs[42]
- **Kuruvungna Springs:** Sole remaining major spring (22,000-25,000 gal/day)[2]—accounts for the majority of current watershed spring discharge
- **Centinela Springs:** EXTINCT since 1930s-40s after water table dropped 150-160 feet[86]
- **La Cienega Springs:** EXTINCT, likely 1920s-1930s
- **Most valley springs:** EXTINCT, various dates 1900-1950
- Current springs account for only **~2% of dry season baseflow**[42] (vs. estimated 10-15% historically)

Cultural Legacy:

- **Kuruvungna: 8,000+ years** of documented Tongva occupation[97][99][21]—one of the oldest continuously occupied sites in Los Angeles Basin
- **Tongva villages** at major springs, with Kuruvungna providing the most complete archaeological record
- **Spanish land grants** explicitly named for water abundance, reflecting springs' economic importance
- **Contemporary significance:** Gabrielino/Tongva Springs Foundation maintains cultural continuity after 8 millennia[15][97]

The Reckoning:

The 1938 *History of Inglewood* prophetically warned: "there is an ominous note in the predictions of those best informed in such matters, that there is daily being taken from the seemingly inexhaustible underground pools of water more than nature is putting back, and that someday there will be a reckoning."[12]

That reckoning arrived within a decade. By the late 1940s, Centinela Springs—once producing 900,000 gallons daily—had gone extinct. The water table had collapsed 150-160 feet. Salt water from the Pacific Ocean intruded into coastal aquifers. The vast La Cienega wetlands dried up. The Ballona Valley springs disappeared beneath pavement.

Today, Kuruvungna Springs stands as both **a testament to resilience** and **a stark reminder of loss**. While this sacred site continues to flow after 8,000 years of human presence, it represents less than 2% of the watershed's historical spring discharge. The springs that once sustained

14,149 acres of wetlands, fed two perennial creeks, and supported thriving indigenous villages have been reduced to scattered seeps producing 2% of their former abundance.

As Los Angeles grapples with climate change, water security, and ecological restoration, the story of the Ballona springs offers profound lessons. These were not minor landscape features—Centinela Springs alone produced nearly a million gallons daily. Their near-total extinction within 50 years (1890s-1940s) demonstrates both the fragility of groundwater-dependent ecosystems and the catastrophic speed with which unsustainable pumping can destroy irreplaceable natural resources.

The few springs that remain—particularly Kuruvungna—deserve recognition, protection, and celebration as "unique remnant features from the historical landscape."[1] They offer tangible connections to both ancient Tongva heritage and pre-urban hydrology. With regional water table recovery through managed aquifer recharge and sustainable groundwater management, there remains hope that some extinct springs might one day flow again.

Appendix A: Named Ranchos and Their Water Sources

Rancho Name	**Grant Date**	**Acreage**	**Grantee**	**Water Source**	**Documented Flow**	**Current Location**
Rancho Aguaje de la Centinela	1837	~14,000	Various	Centinela Springs	269,000-900,000 gal/day[86]	Inglewood
Rancho Rodeo de las Aguas	1838	4,539	María Rita Valdez	Coldwater/Benedict/Franklin Canyon springs	Not documented	Beverly Hills
Rancho Las Ciénegas	1823	4,439	Francisco Avila	Baldwin Hills foothill springs	Not documented	La Cienega Blvd area
Rancho La Ciénega ó Paso de la Tijera	1843	4,219	Vicente Sánchez	Baldwin Hills springs	Not documented	Baldwin Hills, Leimert Park

Rancho Name	Grant Date	Acreage	Grantee	Water Source	Documented Flow	Current Location
Rancho La Ballona	~1840s	14,000	Machado & Talamantes	Ballona Creek, valley springs	Not documented	Culver City, Playa del Rey

Table 4: Spanish/Mexican Land Grants Named for Water Resources with Documented Flows

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Appendix B: Springs Accessibility Guide (2026)

Publicly Accessible Springs

Kuruvungna Springs / Tongva Sacred Springs

- **Address:** 1439 South Barrington Avenue, Los Angeles, CA 90025 (University High School campus)
- **Access:** First Saturday of each month, 10 AM - 3 PM
- **Cost:** Free
- **Current Flow:** 22,000-25,000 gallons/day (watershed's most productive remaining spring)
- **Archaeological Significance:** Over 8,000 years of documented occupation
- **Contact:** Gabrielino/Tongva Springs Foundation
- **Website:** https://gabrielinosprings.com
- **Special Events:** Indigenous Peoples' Day Festival (mid-October annually)
- **Recognition:** California Registered Landmark Site No. 522 (1954); Archaeological Designation CA-LAN-382 (1969)

Franklin Canyon Park

- **Address:** 2600 Franklin Canyon Drive, Beverly Hills, CA 90210
- **Access:** Daily during park hours
- **Features:** Franklin Lake (spring-fed), hiking trails, oak and willow communities
- **Current Status:** Active springs maintain lake through dry seasons
- **Managed by:** Santa Monica Mountains Conservancy and partners
- **Cost:** Free

UCLA Mildred E. Mathias Botanical Garden

- **Address:** UCLA Campus, southeastern corner
- **Access:** Open daily (verify current hours)
- **Features:** Reclaimed-water stream system (2024 renovation), historical arroyo site, diverse plant collections
- **Current Natural Spring Flow:** Minimal (now supplemented with reclaimed water)
- **Cost:** Free (only free public botanical garden in Greater LA)
- **Website:** https://www.botgard.ucla.edu/

Historical Spring Sites (Extinct - Memorial/Educational Visits)

Centinela Springs / Aguaje de Centinela

- **Address:** Centinela Park, Inglewood, CA
- **Historical Flow:** 269,000-404,000 gal/day natural (1888); developed to 900,000 gal/day (1890)[86]
- **Extinction:** 1930s-40s (water table dropped 150-160 feet)[86]
- **Current Status:** California Historical Landmark No. 363 (1976) with commemorative plaque
- **Access:** Public park, open daily
- **Educational Value:** Outstanding example of groundwater overdraft consequences
- **Plaque Text:** "ON THIS SITE BUBBLING SPRINGS ONCE FLOWED FROM THEIR SOURCE IN A DEEP WATER BASIN WHICH HAS EXISTED CONTINUOUSLY SINCE THE PLEISTOCENE ERA"[86]

Private Property (Limited Access)

Coldwater Canyon Springs / Benedict Canyon Springs

- Springs on private residential properties
- Occasionally visible as hillside seeps on public roads
- Not accessible for close inspection
- Minimal current flow (included in 2011 survey's 29 active springs)[42]

Appendix C: Miner's Inch Conversions

California Miner's Inch (used in Hall 1888 report):[98]

- 1 miner's inch = 0.02 cubic feet per second (1/50 cfs)
- 1 miner's inch = 11.22 gallons per minute
- 1 miner's inch = 13,454 gallons per day

Centinela Springs Conversions:

- 20 miner's inches = 224 gpm = 269,000 gal/day
- 30 miner's inches = 337 gpm = 404,000 gal/day
- 50 miner's inches = 561 gpm = 672,000 gal/day
- 67 miner's inches (to reach 900,000 gal/day reported in 1890) = 751 gpm

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End of Corrected Report

Report Revision Notes: This corrected version incorporates documented historical flow rates (particularly Centinela Springs at 269,000-900,000 gal/day), acknowledges spring extinction rather than "unknown status," corrects Tongva occupation to 8,000+ years based on archaeological evidence, and accurately reflects the 2011 SCCWRP finding that current springs account for ~2% of watershed flow with total discharge of only 50,000-75,000 gal/day (not 1.07 million gal/day as previously estimated).